BVT-IF TECHbrief

Wyatt Badger Venturi Tubes
Insert-Type Fabricated Primary Elements

FEATURES:

- **Low Pressure Loss**
- **High Accuracy**
- **Low Installed Cost**
- **Custom Designed**
- **Short Laying Length**

BVTIF 06/2019 6M

Description

The Wyatt Badger **BVT-IF** is a fabricated insert Venturi flow element that offers repeatability and accuracy over a greater range of flow rates and has lower permanent pressure loss than orifice plates, flow nozzles, or traditional Venturi meters. These units can be manufactured from virtually any material to address the needs of your applications. The **BVT-IF** is designed for insertion within the interior of a pipeline and is secured by the adjacent pipe flanges. These Venturi elements are characterized by longevity of service and flexibility in design.

Application

The fabricated insert **BVT-IF** is designed to measure the flow of gases and liquids that have low solids loading. The **BVT-IF** can operate over wide temperature and/or pressure ranges with highly corrosive fluids or gases. The **BVT-IF** has the distinct advantages of minimal weight, low cost, and short laying length. Typical applications range from potable water, cooling water, process water, steam, air flow for fine bubble aeration, combustion air, and natural and process gases.

Low Uncertainty

For pipe Reynolds numbers greater than 75 000, and with a normalized piping configuration, the Wyatt **BVT-IF** provides a flow measurement accuracy of ± 0.50% without flow calibration. With independent flow calibration, Wyatt's Badger Venturi Tubes provide the user with an uncertainty band of ± 0.25%.

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Technical Specifications

Accuracy

For pipe Reynolds numbers greater than 75 000 and normalized piping, the Wyatt **BVT-IF** Venturi tube provides a flow measurement uncertainty of:

± 0.50% for standard QS9001 calibrated meters and
± 0.25% for flow calibrated meters.

Pressure Loss

The permanent pressure loss of Wyatt's Badger Venturi Tube is shown in Figure 1.

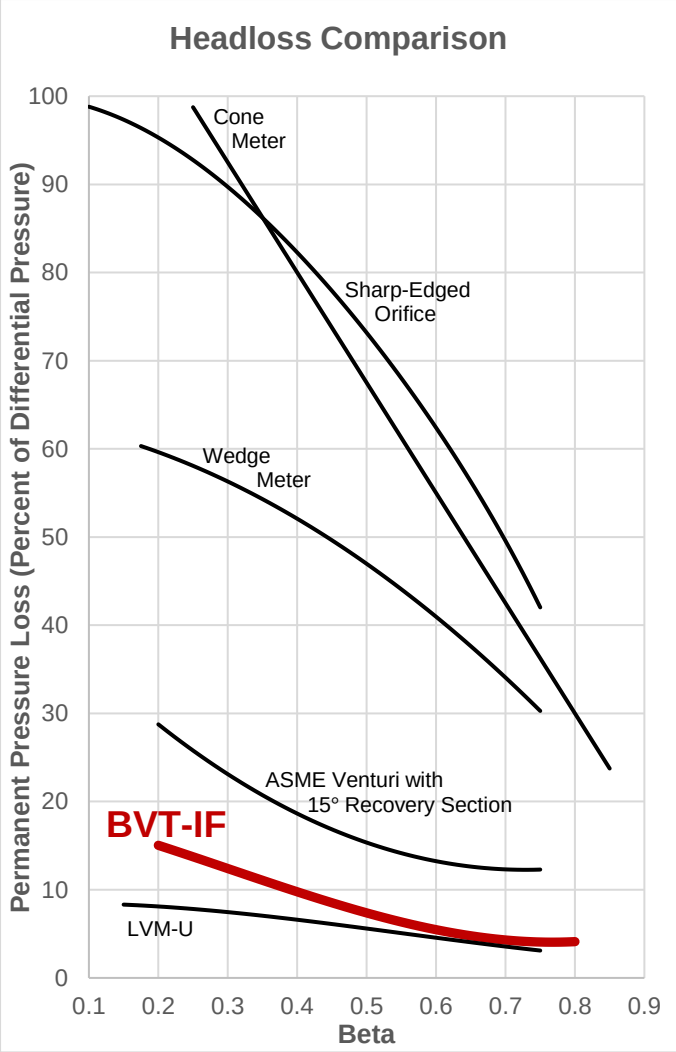


Figure 1

Beta Ratio

Wyatt can furnish **BVT-IF** meters with a wide range of diameter ratios (d/D). This provides users with accurate flow measurement over a broad range of flow rates for a given line size.

Temperature Range

The fabricated **BVT-IF** can operate over a fluid temperature range of -325 °F and +1200 °F (-200 °C and +650 °C).

Pressure Range / End Connections

The **BVT-IF** is designed to operate within the pressure boundary of 4000 PSIG (27 500 kPaG) and can be manufactured to interface with any flange geometry.

Piping Requirements

Designed for full-pipe flow, BVT flow meters may be mounted horizontally, vertically, or at an angle. For recommended upstream piping, refer to Wyatt Engineering TECHspec for the BVT design.

Energy Considerations

Figure 1 compares the headloss of the **BVT-IF** with that of other primary flow elements. The pressure recovery of Wyatt's **BVT-IF** leads to reduced pumping costs. The Wyatt **BVT-IF** has a shorter laying length and exhibits better recovery than standard classical Venturi meters and many other differential producers as well.

Design Concepts

The hydraulic design produces discharge coefficients that are highly predictable and independent of line size. The **BVT-IF** design allows accurate calculation of expansibility factors that are necessary for compressible fluid flow measurement. The smooth transition section minimizes flow noise and erosion.

Signal-to-Noise Ratio

Within the specified flow range and piping conditions, the **BVT-IF** will produce signal-to-noise ratios greater than 98%. This level of performance is essential for sensitive process control and reactive rate-of-flow control applications.

BVT-IF Sizing Table

Inlet Diameter		Throat Diameter		Beta Ratio	Overall Length		Outlet Diameter		ΔP = Differential Pressure of 100.00" wc (24.864 kPaD)						
									Water Flow at 60° F (16° C)					ΔH = Headloss	
(inches)	(mm)	(inches)	(mm)		(inches)	(mm)	(inches)	(mm)	US GPM	US MGD	LPS	m^3/d	$R_D(10^{-3})$	in. wc	kPa
3.068	78	1.500	38.10	0.4889	7.60	193	2.30	58	128.76	0.185	8.123	701.87	119	9.8	2.43
3.068	78	1.800	45.72	0.5867	7.70	196	2.60	66	189.26	0.273	11.940	1031.6	174	7.1	1.76
3.068	78	2.100	53.34	0.6845	7.70	196	2.80	71	266.29	0.383	16.800	1451.5	245	4.5	1.12
4.026	102	2.000	50.80	0.4968	10.10	257	3.00	76	229.19	0.330	14.459	1249.3	161	9.2	2.30
4.026	102	2.400	60.96	0.5961	10.20	259	3.40	86	337.35	0.486	21.283	1838.9	237	6.6	1.64
4.026	102	2.800	71.12	0.6955	10.30	262	3.80	97	475.47	0.685	29.998	2591.8	334	4.2	1.03
6.065	154	3.000	76.20	0.4946	15.20	386	4.60	117	515.50	0.742	32.523	2810.0	240	8.9	2.20
6.065	154	3.600	91.44	0.5936	15.30	389	5.20	132	758.48	1.092	47.853	4134.5	353	6.4	1.58
6.065	154	4.200	106.68	0.6925	15.40	391	5.70	145	1068.5	1.539	67.414	5824.6	498	4.0	1.00
7.981	203	4.000	101.60	0.5012	20.20	513	6.10	155	917.41	1.321	57.879	5000.8	325	8.4	2.09
7.981	203	4.800	121.92	0.6014	20.40	518	6.90	175	1351.5	1.946	85.264	7366.9	478	5.9	1.48
7.981	203	5.600	142.24	0.7017	20.60	523	7.60	193	1906.6	2.746	120.29	10393.1	675	3.7	0.93
10.02	255	5.000	127.00	0.4990	25.20	640	7.70	196	1432.9	2.063	90.40	7810.9	404	8.2	2.05
10.02	255	6.000	152.40	0.5988	25.50	648	8.70	221	2110.1	3.038	133.12	11501.9	595	5.9	1.45
10.02	255	7.000	177.80	0.6986	25.70	653	9.50	241	2975.4	4.285	187.72	16219.1	839	3.7	0.91
12.00	305	6.000	152.40	0.5000	30.30	770	9.20	234	2063.8	2.972	130.20	11249.5	486	8.0	2.00
12.00	305	7.200	182.88	0.6000	30.60	777	10.40	264	3039.5	4.377	191.76	16568.5	716	5.7	1.42
12.00	305	8.400	213.36	0.7000	30.80	782	11.40	290	4287.0	6.173	270.47	23368.7	1009	3.6	0.89
13.25	337	7.000	177.80	0.5283	35.30	897	10.80	274	2823.3	4.066	178.13	15390.0	602	7.3	1.82
13.25	337	8.400	213.36	0.6340	35.70	907	12.10	307	4181.7	6.022	263.83	22794.7	892	4.8	1.20
13.25	337	9.800	248.92	0.7396	36.00	914	13.30	338	5927.2	8.535	373.95	32309.0	1264	3.1	0.77
15.25	387	8.000	203.20	0.5246	40.30	1024	12.30	312	3685.0	5.306	232.49	20086.7	683	7.3	1.81
15.25	387	9.600	243.84	0.6295	40.80	1036	13.90	353	5453.7	7.853	344.08	29728.1	1010	4.9	1.21
15.25	387	11.200	284.48	0.7344	41.10	1044	15.30	389	7726.5	11.13	487.47	42117.1	1431	3.1	0.76
17.25	438	9.000	228.60	0.5217	45.40	1153	13.80	351	4661.3	6.712	294.08	25408.5	763	7.2	1.80
17.25	438	10.800	274.32	0.6261	45.90	1166	15.60	396	6894.5	9.928	434.98	37582.1	1129	4.9	1.21
17.25	438	12.600	320.04	0.7304	46.20	1173	17.20	437	9763.9	14.06	616.00	53222.7	1599	3.1	0.76
19.25	489	10.000	254.00	0.5195	50.40	1280	15.40	391	5752.2	8.283	362.91	31355.2	844	7.2	1.78
19.25	489	12.000	304.80	0.6234	51.00	1295	17.40	442	8504.2	12.25	536.53	46356.6	1248	4.9	1.21
19.25	489	14.000	355.60	0.7273	51.30	1303	19.10	485	12039	17.34	759.56	65626.1	1767	3.0	0.76
23.25	591	12.000	304.80	0.5161	60.50	1537	18.50	470	8278	11.92	522.26	45123.7	1006	7.1	1.76
23.25	591	14.400	365.76	0.6194	61.20	1554	20.90	531	12230	17.61	771.61	66667.1	1486	4.8	1.20
23.25	591	16.800	426.72	0.7226	61.60	1565	22.90	582	17305	24.92	1091.75	94326.8	2103	3.0	0.75
29.25	743	15.000	381.00	0.5128	75.60	1920	23.10	587	12927	18.61	815.55	70463.8	1249	7.0	1.73
29.25	743	18.000	457.20	0.6154	76.50	1943	26.10	663	19086	27.48	1204.13	104037	1844	4.8	1.19
29.25	743	21.000	533.40	0.7179	77.00	1956	28.70	729	26988	38.86	1702.70	147114	2607	3.0	0.74
35.25	895	18.000	457.20	0.5106	90.70	2304	27.70	704	18607	26.79	1173.94	101429	1491	6.9	1.70
35.25	895	21.600	548.64	0.6128	91.80	2332	31.30	795	27461	39.54	1732.53	149690	2201	4.7	1.18
35.25	895	25.200	640.08	0.7149	92.40	2347	34.40	874	38816	55.89	2448.89	211584	3111	3.0	0.73
41.25	1048	21.000	533.40	0.5091	105.80	2687	32.40	823	25320	36.46	1597.43	138018	1734	6.8	1.68
41.25	1048	25.200	640.08	0.6109	107.10	2720	36.50	927	37356	53.79	2356.81	203629	2559	4.7	1.17
41.25	1048	29.400	746.76	0.7127	107.80	2738	40.10	1019	52787	76.01	3330.31	287739	3615	2.9	0.73
47.25	1200	24.000	609.60	0.5079	120.90	3071	37.00	940	33064	47.61	2086.03	180233	1977	6.7	1.66
47.25	1200	28.800	731.52	0.6095	122.40	3109	41.80	1062	48771	70.23	3076.98	265851	2916	4.6	1.15
47.25	1200	33.600	853.44	0.7111	123.10	3127	45.90	1166	68901	99.22	4346.97	375578	4120	2.9	0.72

This sizing table can be used as a guide to aid the user in choosing the proper insert **BVT-IF** for a given application and reflects the most commonly used sizes. Other sizes and special geometries are available, often at no additional cost. Depending on the details of your application, a more appropriate selection, or a more accurate estimation of the performance of a given selection, may be available. Wyatt Engineering encourages users to contact their local Wyatt representatives, or call us directly, for definitive sizing information.

Incompressible Flow Relationships:

$\Delta P_N = 100\ (Q_N / Q)^2$

$\Delta H_N = \Delta H\ (Q_N / Q)^{1.88}$

$Q_N = Q\ (\Delta P / 100)^{0.5}$

Examples:

For a 19.25" x 14.000" BVT-IF, find

ΔP at 20 000 US GPM

ΔH at 20 000 US GPM

Q_N at 750" wc

Solutions: Found using the "Incompressible Flow Relationships"

$\Delta P_N = 100\ (20\ 000 / 12039)^2 = 275.98$" wc

$\Delta H_N = 3.0\ (20\ 000 / 12039)^{1.88} = 7.8$" wc

$Q_N = 12039\ (750 / 100)^{0.5} = 32\ 970$ US GPM

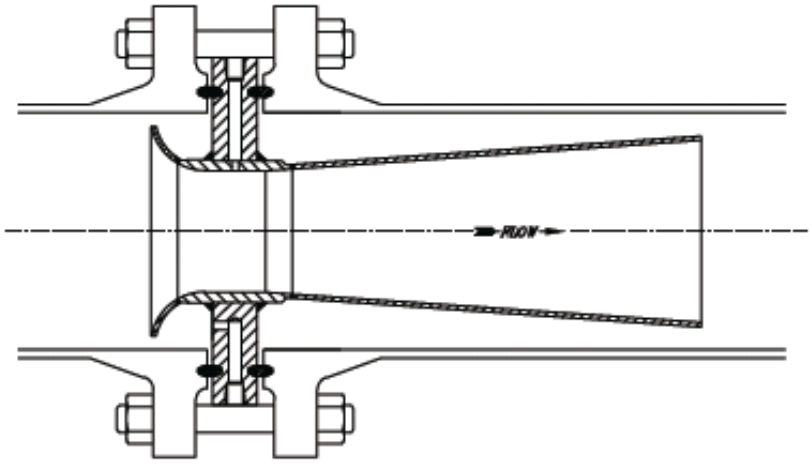
Available Options

The Wyatt Fabricated Insert BVT-IF is available in several styles and many different alloys specific for your applications.

Materials of Construction

The nature of the **BVT-IF** fabricated design allows the flow element to be constructed from practically any material. Examples of some of the alloys employed:

- Carbon Steel
- Stainless Steels
- Super Duplex
- Inconel
- Hastelloy B & C
- Monel
- Titanium
- Cr-Mo Alloys
- Nickel
- Tantalum
- Zirconium



BVT-IF

Consult your local representative or Wyatt Engineering for information on other materials of construction.

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